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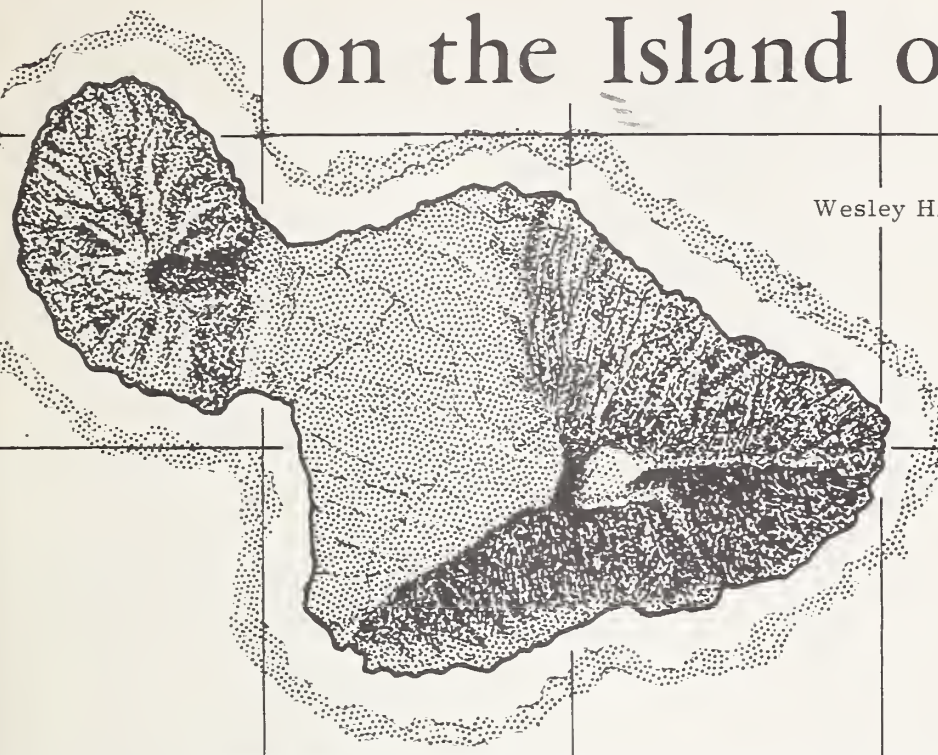


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# Plantation Timber on the Island of Maui--1967



Wesley H. C. Wong, Jr.    Herbert L. Wick    Robert E. Nelson

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U.S. Pacific Southwest Forest and Range  
Experiment Station, Forest Service,  
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Berkeley, California 94701

and

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Department of Land and  
Natural Resources,  
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Honolulu, Hawaii 96813



## Foreword

This report is the last of a series about planted forests on major islands in the State of Hawaii. Reports have been published for the islands of Hawaii (1966), Kauai (1967), Lanai (1967), Molokai (1968), and Oahu (1968). Summarized here are the results of a survey of timber in planted forests on the Island of Maui. This inventory supplements the initial Forest Survey of the State completed in 1963. That survey indicated the importance of planted forests as a timber resource, but provided no details. This bulletin reports: (a) location and acreage of each planted stand, (b) species composition and age of stand, (c) timber volume and quality, and (d) ownership of planted timber.

The study is a cooperative undertaking of the Division of Forestry, Hawaii Department of Land and Natural Resources, and of the Pacific Southwest Forest and Range Experiment Station, Forest Service, U.S. Department of Agriculture. It was conducted under the direction of Robert E. Nelson, Director, Institute of Pacific Islands Forestry, Pacific Southwest Forest and Range Experiment Station. Nobuo Honda, Forester, Hawaii Division of Forestry, helped develop plans for the plantation inventory.

In 1966, responsibility for supervision of the Forest Survey in the Pacific Coast States and Hawaii was assigned to the Pacific Northwest Forest and Range Experiment Station, but field work in Hawaii will continue to be a joint effort of the Hawaii State Division of Forestry and the Pacific Southwest Forest and Range Experiment Station.

Many individuals aided in various phases of the survey. Special acknowledgment is due the field crew: Forester Wesley Wong and crew members Kazuo Tamura and Jacob Mau, Jr.—all of the Hawaii Division of Forestry.

E. M. Hornibrook, formerly in charge of the Forest Survey, Pacific Southwest Station, and Russell K. LeBarron, former Forest Ecologist, Hawaii Division of Forestry, aided in developing plans for the study.

Robert M. Miller, Systems Analyst, Pacific Southwest Station, developed specifications for automatic data processing. The computing center at the University of Hawaii processed the data.

Karl H. Korte, District Forester, Maui, and Tom K. Tagawa, State Forester, provided generous cooperation in the conduct of the survey.

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U.S. Forest Service research in Hawaii is conducted in cooperation with the Division of Forestry, Hawaii Department of Land and Natural Resources.

Wong, Wesley H.C., Jr.; Wick, Herbert L.; and Nelson, Robert E.

1969. *Plantation timber on the Island of Maui—1967*. Berkeley, Calif., Pacific SW. Forest & Range Exp. Sta. 42 p., illus. (U.S.D.A. Forest Serv. Resource Bull. PSW-11)

Summarizes the results of an inventory of timber in planted forests on the Island of Maui. It provides information on (1) location and acreage of each planted stand, (2) species composition and age, (3) timber volume and quality, and (4) ownership. This information supplements that of the initial Forest Survey.

OXFORD: (969):228.7—05.

RETRIEVAL TERMS: planted forests; surveys; stand composition; stand volume; forest ownership; Hawaii (Maui).

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## *The Authors*

WESLEY H. C. WONG, Jr., a native of Wailuku, Maui, received his bachelor's degree in forestry from Oregon State University in 1964. As timber survey forester for the Hawaii Division of Forestry, he has been assigned primarily to the forest inventory of the State. HERBERT L. WICK is working on mensuration problems and forest survey techniques. A native of Seattle, Washington, he earned a bachelor's and master's degree in forestry at the University of Washington. He worked 3 years in the Pacific Northwest with the Forest Service before joining the staff of the Institute of Pacific Islands Forestry in 1967. ROBERT E. NELSON directs the Pacific Southwest Station's Institute of Pacific Islands Forestry, headquartered in Honolulu. He joined the Forest Service in 1941, after earning a forestry degree at the University of California. He became field supervisor of the California State Cooperative Soil-Vegetation Survey in 1949. Since 1957, he has been in charge of the Station's Hawaii office.





*Eucalyptus robusta* comprises most of the sawtimber volume on Maui. This 65-year-old robusta stand (No.6114) in the Koolau Forest Reserve averages nearly 70,000 board feet of sawtimber per acre.



**M**aui, second largest of the Hawaii Islands, holds some of the finest agricultural lands in the State. Sugar production is the most important industry there. Pineapple and truck farming are also important activities on the island.

Two separate volcanic mountain ranges joined by a low isthmus form this 728-square-mile island. The west side is geologically older. The mountains there are ruggedly dissected, with several peaks rising over 5,000 feet. On the windward side, the steep ridges and canyons drop sharply into the sea. On the leeward, or westerly, side of western Maui, geologic processes have developed a sloping coastal plain, dissected by streams.

On the east side, Mount Haleakala rises to 10,023 feet. Now dormant, Haleakala last erupted in 1750. The molten lava added to the crusty southern fringe of the island. The volcano's rugged and lushly forested windward slopes also terminate in steep sea cliffs. The leeward slopes are also steep but not so ruggedly dissected. These dry, southwest slopes are sparsely vegetated--only a few shrubs and herbaceous plants grow. The upper slopes and summit area of Haleakala are rocky and nearly barren of vegetation.

Cattle graze on a large acreage throughout much of Maui. Although much of the grazed land is forested, grazing is excluded from much of the Forest Reserves.

Tourism is important to the island's economy. Maui's historic Lahaina Coast, scenic Hana, and Mount Haleakala (considered the legendary house of the sun) attract thousands of tourists annually.

More than half of Maui is forest land.<sup>1</sup> Of the 466,000 acres, 120,000 acres are commercial forest land holding about 108 million board feet of sawtimber (figs. 1,2). In addition, there are about 143,000 acres of noncommercial forest land, and 40,000 acres of nonforest rockland and pali.

Forest Reserves amount to 159,000 acres,<sup>2</sup> mostly in the mountainous areas. The Reserves are public and private lands administered by the State for management and protection of watershed and other forest values. However, private lands in Reserves and not under surrender agreement do not receive management, but only protection and zoning.

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<sup>1</sup>Nelson, Robert E., and Wheeler, Philip R. *Forest Resources of Hawaii--1961*. Forestry Div., Dep. Land and Natural Resources, State of Hawaii, in cooperation with the Pacific SW. Forest & Range Exp. Sta., Forest Serv., U.S. Dep. Agr., 48 p., illus. 1963.

<sup>2</sup>Hawaii Dep. Land and Natural Resources. Report to the Governor--July 1, 1966 to June 30, 1967. 83 p., illus. 1967.

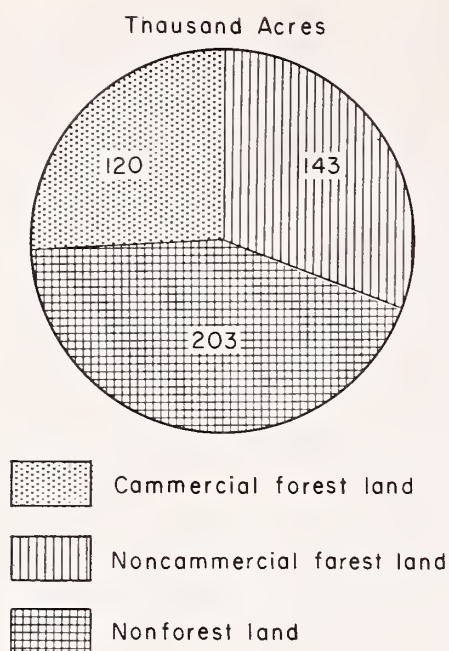


Figure 1.--Forest and nonforest land acreages on the Island of Maui, 1961.

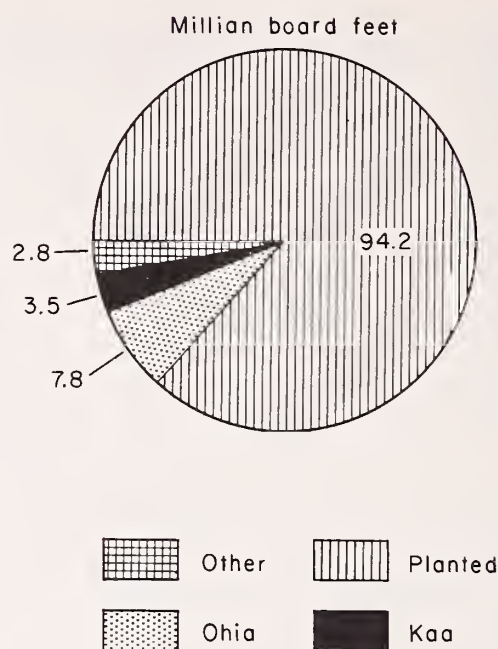


Figure 2.--Sawtimber volumes on the Island of Maui. (Planted figure is current volume; others are 1961 data.)

Most of the commercial forest land has a cover of native or naturalized types, but they hold little volume of sawtimber. Only about 21,000 acres of ohia (*Metrosideros collina*), koa (*Acacia koa*),<sup>3</sup> or naturalized types were considered commercial types in the initial Forest Survey.<sup>4</sup> Sawtimber stocking averages about 670 board feet per acre for a total of only 14 million board feet. Noncommercial forest or brush types occupy nearly 96,000 acres of the commercial forest land.

Forest plantings were started on Maui by ranchers and sugar companies in the late 1800's for the production of fuelwood, fenceposts, and timber; for erosion control, shelterbelts, and shade; and for esthetic purposes. The Territorial Division of Forestry, assisted by the Civilian Conservation Corps, greatly expanded reforestation efforts in the 1930's. They concentrated on providing a vegetative cover to protect watersheds. Since 1960, the Division of Forestry has accelerated its reforestation program.

Although the acreage of planted forests on Maui is small, they hold six times more volume of sawtimber than native forests. And timber yield and quality are higher. The total volume of plantation timber is 94 million board feet. Most is readily accessible and has a good potential for industrial use.

In 1967, we started a stand-by-stand inventory to obtain detailed information on plantation acreage, timber volume and quality, and ownership. This report summarizes data compiled for each plantation stand.

<sup>3</sup>A small acreage of planted koa forest is included in the over-all acreage of the native forest type because of the difficulty of differentiation. In general, the planted koa forest has not developed into good timber stands.

<sup>4</sup>Nelson and Wheeler. Op. cit.



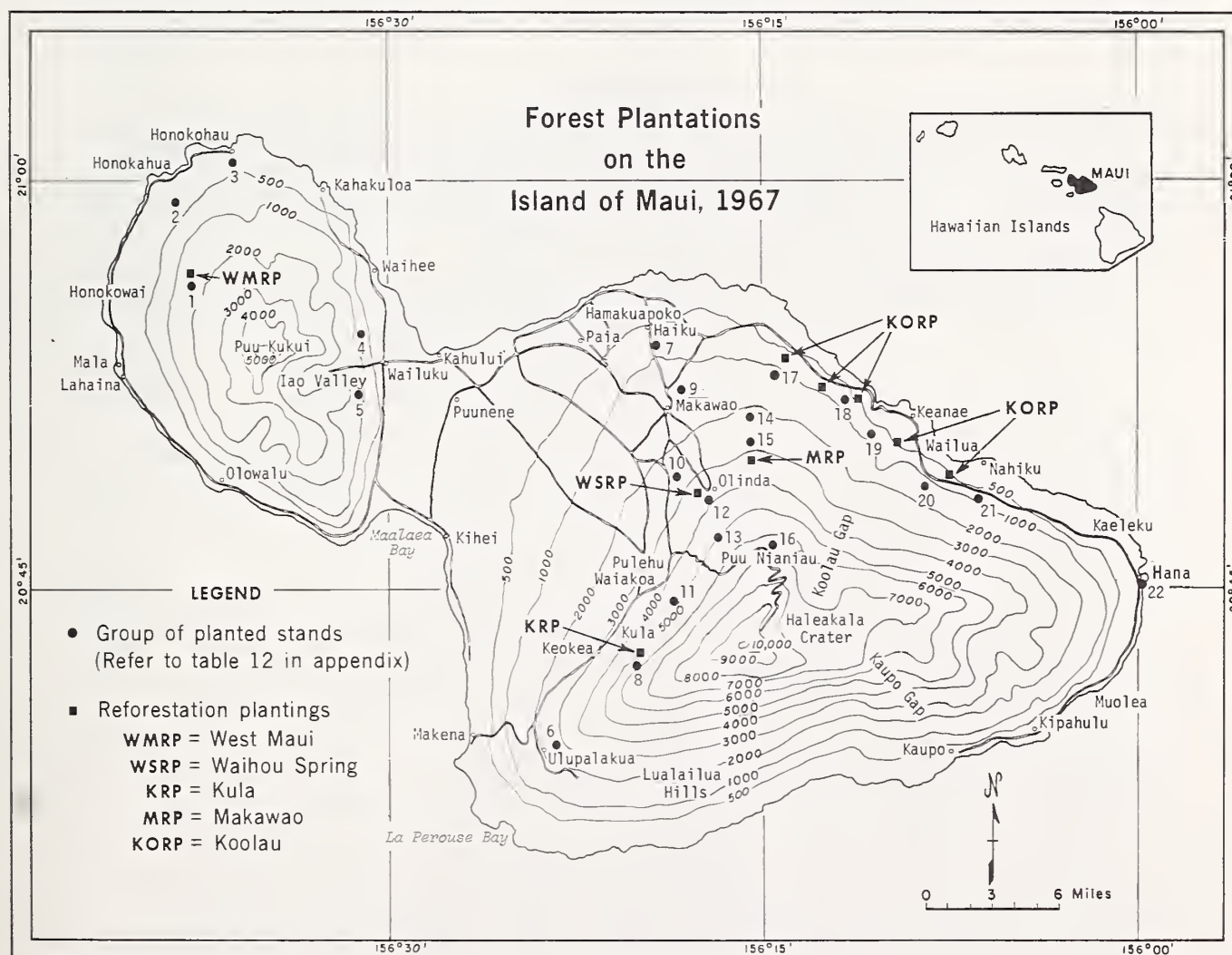
# Plantation Timber Resource

## Area

Forest plantations on Maui total more than 10,000 acres. This includes commercial forest types,<sup>5</sup> such as robusta eucalyptus, and noncommercial types, such as paper-bark. Most forest plantations are concentrated in two general areas on the west and northwesterly slopes of Haleakala (see map and tables 1-4, 11, and 12). Small plantings lie next to cultivated and pasture areas, in gullies, and on steep slopes on nearly all parts of the island. These scattered plantings make up a significant portion of the forest plantation resource.

We inventoried 6,063 acres of commercial forest plantations on the Island of Maui, in stands from 2 acres to 120 acres in size (tables 1-4; fig. 3). Most of the individual stands tallied are small. Only 20 were 50 acres or larger for a total of 1,660 acres; stands 5 to 49 acres in size aggregated 4,167 acres; and 75 stands from 2 to 4 acres in size totaled 236 acres.

<sup>5</sup>See definitions of terms in appendix.





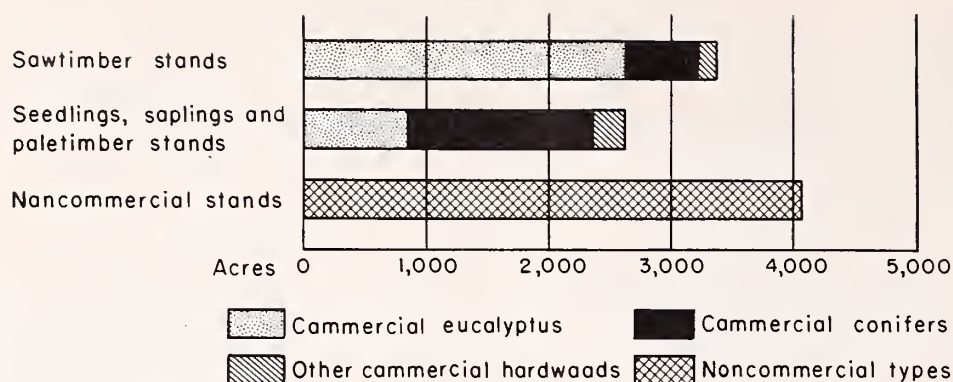


Figure 3.--Acreage of commercial and noncommercial plantation stands by stand-size class and forest type, Island of Maui, 1967.

About 3,400 acres of the commercial forest plantations are sawtimber stands. Another 2,660 acres are recently planted seedling, sapling, and poletimber stands of commercial species. Of this acreage, 1,500 acres are conifers and 1,160 acres are hardwoods.

Eucalypts, mainly *Eucalyptus robusta*, make up 77 percent, or nearly 2,630 acres of the sawtimber stands. Hardwood sawtimber stands other than eucalypts total 170 acres; and there are over 600 acres of commercial conifer sawtimber stands.

In addition to the commercial forest plantations, there are about 4,060 acres of noncommercial types, mostly paper-bark, bluegum eucalyptus, and ironwood.

## Volume

Forest plantations on Maui contain about 94 million board feet of sawtimber (tables 5-8). Of this volume about 92 million board feet are in stands 5 acres and larger; 2 million board feet are in stands 2 to 4 acres in size.

Sawtimber includes 82 million board feet of eucalyptus of which robusta eucalyptus alone accounts for 72.7 million board feet (fig. 4). Other volume in hardwoods totals only 1.5 million board feet. Commercial conifer sawtimber totals 10.6 million board feet, mostly redwood and Norfolk-Island-pine.

In the stands 5 acres and larger, about 54 percent of the sawtimber volume is in trees 19 to 29 inches d.b.h. (table 8); 27 percent in trees smaller than 19 inches d.b.h.; and 19 percent in trees 29 inches d.b.h. and larger.

Growing stock volume in planted sawtimber stands amounts to about 18 million cubic feet (tables 5-8). About 85 percent or 15.5 million cubic feet is in eucalypts—robusta eucalyptus alone totaling some 13.4 million cubic feet. Other hardwoods account for only 0.4 million cubic feet. In conifers, mostly redwood, there are 2.2 million cubic feet.

An additional volume of growing stock is in the poletimber, sapling, and seedling stands, but they were not measured.

Wood in cull trees in planted sawtimber stands 5 acres and larger totals about 886,000 cubic feet (table 9). Sawtimber stands of 2 to 4 acres in size and the 4,060 acres of noncommer-

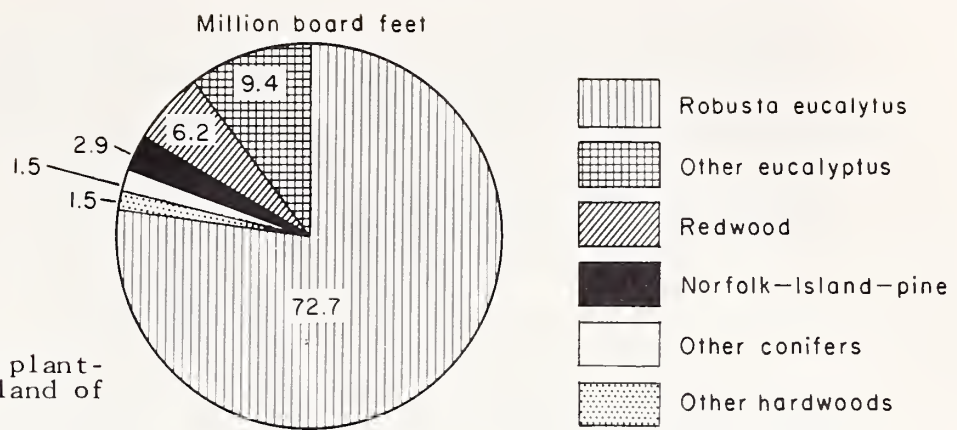


Figure 4.--Sawtimber volume in planted stands by species group, Island of Maui, 1967.

cial plantations hold an additional volume of wood in cull trees, but these stands were not measured. Wood from some trees now considered noncommercial species may have some potential for industrial use.

## Ownership

The State of Hawaii owns 5,076 acres, or nearly half of the total forest plantation acreage on Maui (tables 2,3,11). The remainder, except for 4 acres of noncommercial type in Federal holdings, is privately owned.

A little over half, or 2,792 acres of the State-owned forest plantations are commercial types; 2,284 acres are noncommercial types.

Private holdings of commercial forest types total 3,271 acres. Noncommercial types in private ownership amount to 1,776 acres.

In volume, the State owns only 15 percent (13.5 million board feet) of the timber because a substantial portion of its plantations are the younger seedling, sapling, and pole-size stands (tables 6,7,10,11). A large portion of the private plantations are sawtimber size with higher yields: 85 percent or 78.5 MMBF.

## Age of Stands

The 2,040 acres of commercial forest plantation stands more than 40 years old (table 4) were planted in the late 1800's and early 1900's, primarily for fuel, fence posts, shelterbelts and erosion control. Commercial stands planted from 1926 to 1945 total 1,713 acres. Much of this acreage was planted between 1935 and 1941 by the Civilian Conservation Corps. Between 1946 and 1967, 2,310 acres were planted. The bulk of this acreage has been planted by the State Division of Forestry since the early 1960's.

There are 1,647 acres of noncommercial plantations more than 40 years old and 2,417 acres less than 40 years old.

## Stand Yields

Stand yields differ greatly with stand age, species, site, history and condition of stand, and other factors. The average

volume of sawtimber in the planted sawtimber stands on Maui is 27,700 board feet per acre. The highest average net volume measured was 80,200 board feet per acre in a robusta eucalyptus stand about 60 years old (stand No. 6146; see table 11). The next highest was in a stand of robusta eucalyptus yielding about 77,500 board feet per acre (stand No. 6118; see table 11).

## Timber Quality

Bangalay eucalyptus sawtimber excels other species in quality, based on its proportion of volume in grades 1 and 2 factory lumber logs. Twenty-seven percent of the Bangalay eucalyptus sawtimber is in grade 1, and 17 percent in grade 2 logs (table 10). Robusta eucalyptus, the hardwood species in greatest volume, has 25 percent of its volume in grade 1 and 12 percent in grade 2 logs. Conifer species were not log-graded.

## Opportunity for Industrial Development

Most of Maui's native or naturalized forests are not merchantable timber types and are often just brush. These poorly stocked or nonstocked commercial forest lands contain only small amounts of merchantable timber. Only 21,000 of the 116,000 acres of native or naturalized forest types are considered merchantable timber types, and these forests hold only about 14 million board feet of sawtimber.

Although continued harvesting of small amounts of fence posts, fuelwood, and miscellaneous products from native forests is likely, practically none of the native stands offers prospects for sawtimber harvest.

Planted forests, in contrast to the native forests, have grown rapidly and now yield high volumes of timber. Most of the tree planting that produced this timber resource was not done primarily to grow sawtimber. Instead, trees were planted to control erosion, improve watershed cover, and provide fuelwood. Therefore, species planted were not necessarily selected on the basis of wood quality, but on the basis of adaptability and rapid growth. *Eucalyptus robusta* was highly favored; so were several species that now offer little or no potential for sawtimber, such as ironwoods (*Casuarina* spp.) and paper-bark (*Melaleuca leucadendron*).

Some of these early plantings demonstrate that timber production potentials are far greater than might be inferred from the data on present total sawtimber volumes. We know that many valuable introduced timber species are adapted to the different forest sites. Timber yields can be prodigious. Under management, an average annual sawtimber growth rate of 1,000 board feet per acre can be expected from well-stocked forests on good sites. And stands can be harvested within 30 to 50 years after establishment.

The present timber resource is large enough to support a small sawmilling industry. And it has the potential to develop into a



much larger timber resource as a base for a significant local industry. Such an industry will depend upon the expansion of local markets and perhaps export markets for the specialized products for which the timber is useful.

If only 20 percent of the 120,000 acres of presently little-used and unmanaged commercial forest land were planted to introduced species and managed, timber production could amount to about 24 million board feet annually in 30 years. This potential is significant considering that Hawaii now imports each year some 100 million feet of wood.

Recent forestation efforts by the State are in part an attempt to capitalize on this potential. Species are being selected with consideration for wood qualities and adaptability to specific sites. Plantings are made in large blocks on nonstocked lands or lands where the present forests are of particularly poor quality.

Since 1956, about 1,800 acres of land on Maui have been forested by the State Division of Forestry. Forestation efforts should be expanded. The amount of forestation accomplished during the next 10 years will determine in large part the amount of harvestable timber that might be available 30 to 40 years from now as a base for an expanded industry.

## Multiple Values of Forests

Forests provide many values besides timber. On Maui, their value for watershed protection and for recreation use exceeds their value for timber. Plantations established primarily for watershed protection and erosion control have greatly improved the landscape and increased forest recreation opportunities. Planted forests of introduced trees now provide the most attractive and heavily used forest recreation sites on the island. They also can provide improved wildlife habitat. These multiple benefits of planted forests accrue continuously year after year. In addition, timber can be harvested periodically without detracting from, and often enhancing, the recreation and watershed values.

Because vast acreages of mountain lands on Maui must be maintained in forest cover, public land managers and private owners, too, should develop all the potential benefits latent in these lands. For it has been demonstrated in the existing plantations that forestation can enhance recreation use, watershed value, timber production, and wildlife habitat.





Potential of Maui's forests is illustrated by these three species: (A) 7-year-old stand of saligna eucalyptus, a species highly favored in recent reforestation; (B) 35-year-old redwood stand holding more than 72,000 board feet per acre--a species excelling all other conifers in sawtimber volume; (C) planted Norfolk-Island-pine stand in the Haiku area that averages 76,000 board feet per acre of sawtimber.

A



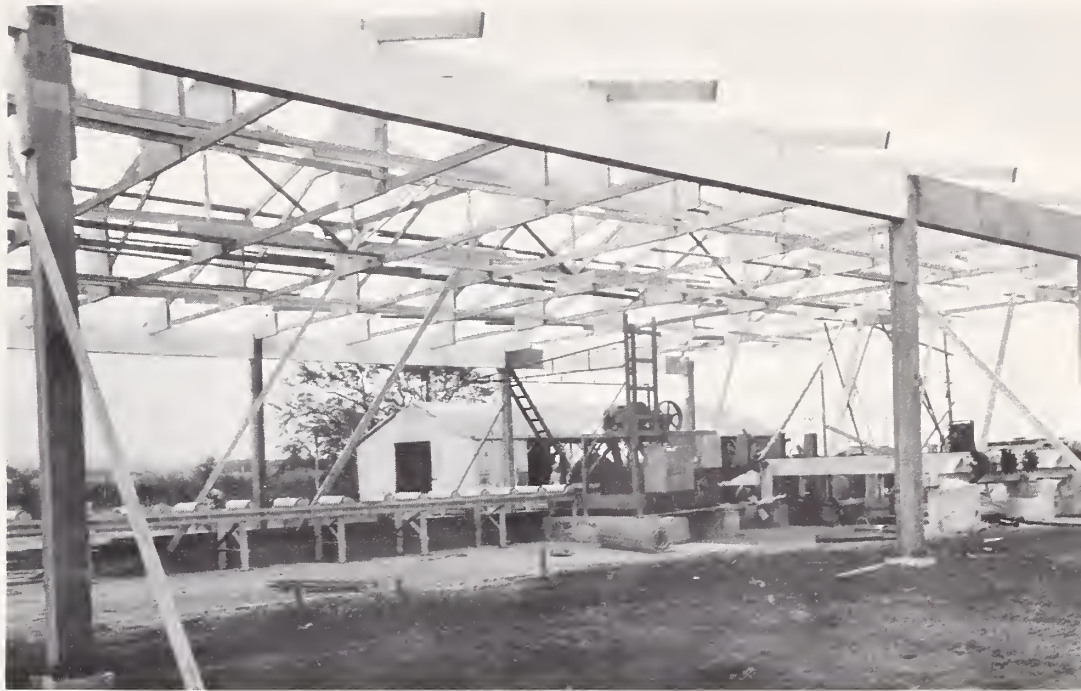
B



C



A new sawmill on Maui has been designed to process timber from planted forests.



Shelterbelts of eucalypts help protect pineapple fields on exposed areas.

Planted forests of mixed species provide recreation sites, such as Kaumahina State Park near Keanae, developed by the Hawaii Division of Forestry.





# Appendix

## Definitions

### Commercial and Noncommercial

*Forest land:* Land at least 10 percent stocked by forest trees of any size, or formerly having such tree cover and not currently developed for other use; and land supporting shrubs, the crowns covering more than 50 percent of the ground

*Commercial forest land:* Forest land that is producing or can produce crops of industrial wood (usually sawtimber) and is not withdrawn from timber use.

*Noncommercial forest land:* (a) *Productive-reserved* forest land withdrawn from timber use through statute or administrative regulation, and (b) *unproductive* forest land incapable of yielding crops of industrial wood because of adverse site conditions.

*Forest plantation:* Planted forests in which at least 10 percent of the growing space is occupied by planted trees (introduced species in this report), regardless of native species predominance.

*Commercial forest plantation:* A plantation of commercial tree species on commercial forest land.

*Noncommercial forest plantation:* A plantation of noncommercial tree species or of commercial tree species planted on noncommercial forest land.

*Commercial tree species:* Tree species suitable for industrial wood products. Species suited only for fuelwood or fence posts are excluded. The following commercial tree species were tallied on plots:

<i>Scientific Name</i>	<i>Common Name</i>
<i>Acacia koa</i>	koa
<i>Albizia falcata</i> ( <i>A. moluccana</i> )	Molucca albizzia
<i>Araucaria cunninghamii</i>	hoop-pine
<i>Araucaria excelsa</i>	Norfolk-Island-pine
<i>Chamaecyparis lawsoniana</i>	Port-Orford-cedar
<i>Cinnamomum camphora</i>	camphor-tree
<i>Cryptomeria japonica</i>	sugi
<i>Eucalyptus botryoides</i>	bangalay eucalyptus
<i>Eucalyptus citriodora</i>	lemon-gum eucalyptus
<i>Eucalyptus paniculata</i>	gray ironbark eucalyptus
<i>Eucalyptus pilularis</i>	blackbutt eucalyptus
<i>Eucalyptus resinifera</i>	kinogum eucalyptus

<i>Eucalyptus robusta</i>	robusta eucalyptus
<i>Eucalyptus saligna</i>	saligna eucalyptus
<i>Eucalyptus sideroxylon</i>	red-ironbark eucalyptus
<i>Eucalyptus</i> spp.	unidentified eucalyptus
<i>Fraxinus uhdei</i>	tropical ash
<i>Grevillea robusta</i>	silk-oak
<i>Pinus patula</i>	jelecote pine
<i>Pinus pinaster</i>	cluster pine
<i>Pinus radiata</i>	Monterey pine
<i>Sequoia sempervirens</i>	redwood
<i>Thuja plicata</i>	western redcedar
<i>Toona ciliata</i> var. <i>australis</i>	Australian toon
<i>Tristania conferta</i>	brushbox

Other frequently planted commercial species not tallied in plots:

<i>Scientific Name</i>	<i>Common Name</i>
<i>Acacia melanoxylon</i>	blackwood acacia
<i>Cedrela odorata</i>	Spanish-cedar
<i>Eucalyptus deglupta</i>	bagras eucalyptus
<i>Eucalyptus</i> spp.	unidentified eucalyptus
<i>Pinus elliottii</i>	slash pine
<i>Swietenia macrophylla</i>	Honduras mahogany
<i>Syncarpia glomulifera</i>	turpentine-tree

*Noncommercial tree species:* Tree species not now considered suitable for industrial products. The following were tallied on plots:

<i>Scientific Name</i>	<i>Common Name</i>
<i>Acacia confusa</i>	Formosa koa
<i>Acacia decurrens</i>	black-wattle acacia
<i>Aleurites moluccana</i>	kukui
<i>Casuarina</i> spp.	ironwood
<i>Cheirodendron</i> spp.	olapa
<i>Cupressus macrocarpa</i>	Monterey cypress
<i>Cupressus</i> spp.	cypress
<i>Eucalyptus globulus</i>	bluegum eucalyptus
<i>Eucalyptus</i> spp.	unidentified eucalyptus
<i>Ficus</i> spp.	fig
<i>Melaleuca leucadendron</i>	paper-bark
<i>Melia azedarach</i>	pride-of-India
<i>Sophora chrysophylla</i>	mamani

Other frequently planted noncommercial tree species not tallied on plots:

<i>Scientific Name</i>	<i>Common Name</i>
<i>Eugenia cumini</i>	Java-plum

<i>Eucalyptus</i> spp.	unidentified eucalyptus
<i>Juniperus</i> spp.	juniper
<i>Spathodea campanulata</i>	African tuliptree

*Hardwoods:* Dicotyledonous trees; usually broadleaved.

*Conifers:* Coniferous trees; usually evergreen, having needle or scale-like leaves. Also generally known as softwoods.

*Forest types:* Forests which are predominantly of a single species and in which no other species makes up 25 percent or more of the stand, are designated by the single species such as robusta eucalyptus type, ohia type, or tropical ash type. Otherwise, or for grouping of area statistics, they are designated:

*Eucalyptus:* Planted stands predominantly of eucalyptus species.

*Hardwood:* Planted stands predominantly of hardwoods other than the eucalypts.

*Conifer:* Planted forests predominantly of conifers.

## Class of Timber

*Growing stock:* Live trees of good form and vigor and of species suited for industrial wood (commercial species).

*Sawtimber trees:* Live trees of commercial species of at least 11 inches diameter breast height which contain a butt half-log or a log which meets the specifications of standard lumber, or tie and timber log grades.

*Poletimber trees:* Live trees of commercial species between 5 and 10.9 inches d.b.h., having soundness and form necessary to develop into sawtimber trees.

*Saplings and seedlings:* Live trees of commercial species between 1 and 4.9 inches d.b.h. and less than 1 inch, respectively, which show promise of becoming sawtimber trees.

*Sound cull trees:* Live trees 1 inch d.b.h. or larger which do not qualify as growing stock because of species (noncommercial species), poor form, or excessive limbs.

*Rotten cull trees:* Live trees 1 inch d.b.h. or larger which are not growing stock or sound cull because of excessive rot.



## Volume

*International 1/4-inch kerf log rule:* A formula rule for estimating the board-foot volume of logs, by 4-foot log sections;  $V$  equals  $0.905 (0.22D^2 - 0.71D)$ .

*Sawtimber volume:* The net volume of the sawlog portion of sawtimber trees, in board feet (International 1/4-inch rule).

*Saw-log portion:* That part of the main bole of sawtimber trees between the stump and the merchantable top.

*Merchantable top:* The point on the bole above which a merchantable saw log cannot be obtained; i.e., the point where the main stem divides into limbs or is less than 8 inches diameter inside bark.

*Growing stock volume:* Volume in cubic feet of sound wood in the bole of sawtimber and poletimber trees from stump to a minimum top diameter inside bark (d.i.b.) of 4 inches, or to the point where the main stem divides into limbs.

*All timber volume:* Volume in cubic feet of sound wood in the bole of growing stock and cull trees 5 inches d.b.h. or larger, from a stump to a minimum top diameter inside bark (d.i.b.) of 4 inches.

## Stand-Size Classes

*Sawtimber stands:* Stands at least 10 percent stocked with growing-stock trees, half or more in sawtimber and poletimber trees, and sawtimber stocking at least equal to poletimber.

*Poletimber stands:* Stands failing to qualify as sawtimber but at least 10 percent stocked with growing-stock trees, at least half poletimber.

*Sapling and seedling stands:* Stands not qualifying as sawtimber or poletimber, but at least 10 percent stocked with growing-stock trees.

*Nonstocked area:* Commercial forest lands less than 10 percent stocked with growing-stock trees.

## Miscellaneous

*Diameter breast height (d.b.h.):* Tree diameter in inches, outside bark, measured at 4-1/2 feet above the ground for normal trees, and 18 inches above the stilt or swell for abnormal trees.

*Industrial wood:* Commercial roundwood products, such as saw logs, veneer logs, and pulpwood. Fuelwood and fence posts are excluded.

*Log grades:* A classification of logs based on external characteristics as indicators of quality or value of lumber the logs will yield. Grade 1 is the highest quality, grade 2 intermediate, and grade 3 the lowest quality of standard hardwood factory lumber logs.<sup>6</sup> Grade 4 logs are suitable for ties and timbers.

*Timber quality:* Based on log grades unless stated otherwise. Characteristics of wood such as density, strength, color, and shrinkage, are also measures of quality. However, they are usually inherent in a species.

## Inventory Procedure

Area and volume statistics presented in this report were developed plantation stand by plantation stand. First, individual forest plantations of 2 acres or more were identified and delineated on aerial photographs through stereoscopic study. Each plantation was given a stand number and classified as to type and stand-size group. The area of each plantation was measured from the photograph. Ownership and stand age were determined from maps and other records. Field examination of each plantation allowed for correcting delineations, classifications, and acreages.

Next, timber-volume plots were located on the ground in each commercial forest plantation of 5 acres and larger having saw-timber trees. The sample plot locations were selected at random from a grid of points overlaid on the aerial photograph. Two or more sample locations, depending on stand acreage and variability, were selected in each stand. At each location, tree measurements were made from which timber volume and quality could be computed and expanded. Detailed measurements were made on a "main" plot at each location, supplemented by additional but less detailed data on two "satellite" plots. All plots were variable plots with a basal area factor of 20.

Finally, the data were processed through a specially prepared computer program. Tree measurements were converted to volume units on a per-acre basis, averaged for the plots in a stand, and expanded for the acreage of the stand. The computer output consisted of tabular data for each stand and summaries of stand data by forest reserves.

Volumetric data for stands 2 to 4 acres in size were extrapolated from closely similar measured stands and added to the computer processed data.

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<sup>6</sup>U.S. Forest Products Laboratory. *Hardwood log grades for standard lumber--proposals and results*. U.S. Forest Serv. Forest Prod. Lab. Rpt. 1737, 15 p., illus. 1953.



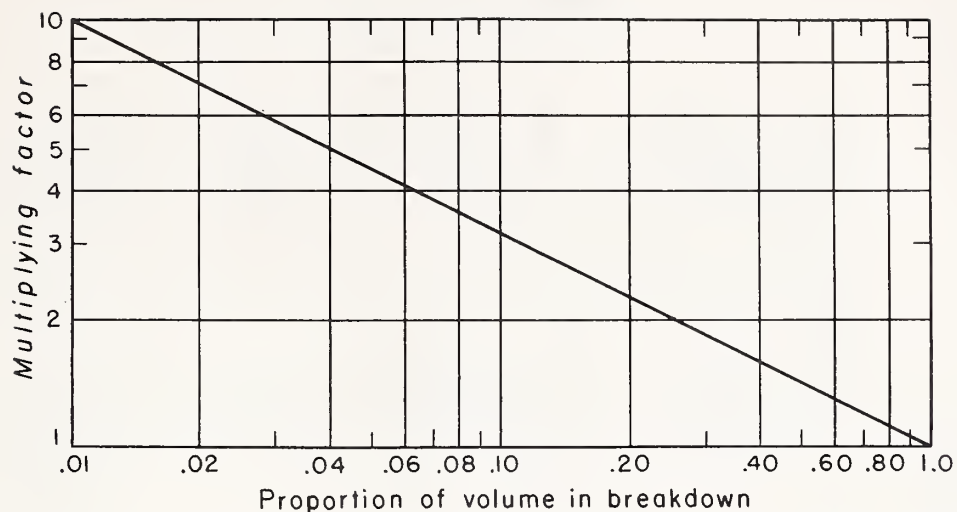


Figure 5.--Adjustment of sampling error for volume breakdown.

The accuracy goal for this inventory was  $\pm 20$  percent per 5 million net board feet of sawtimber in a stand, at the level of one standard error. The reliability of estimates for each forest reserve, based on measured stands only, are shown below. Two chances out of three the estimated volume does not vary from the actual by greater than the sampling error indicated (fig. 5).

<i>Forest Reserve</i>	<i>Total volume (MBF)</i>	<i>Sampling error (percent)</i>
Koolau	63,650	5.0
Kula	7,457	14.9
West Maui	537	26.3
Outside Forest Reserve	19,198	4.5

Table 1.—Area of forest plantations by forest reserve and forest type, Island of Maui, 1967

Forest reserve	Commercial forest types			Total commercial types	Total noncommercial types	Total all types
	Commercial forest types					
	Eucalyptus <sup>1/</sup>	Hardwoods <sup>2/</sup> Conifers				
Acres						
Koolau	2,194	7	35	2,236	2,257	4,493
Kula	42	89	1,137	1,268	293	1,561
Makawao	172	306	5	483	96	579
Waihou Spring	--	20	12	32	5	37
West Maui	34	--	43	77	52	129
Outside reserve	1,023	70	874	1,967	1,361	3,328
Total	3,465	492	2,106	6,063	4,064	10,127

<sup>1/</sup> Includes turpentine-tree and brushbox.

<sup>2/</sup> Except eucalypts.



Table 2.—Area of forest plantation by forest reserve, ownership class,<sup>1</sup>  
and forest type, Island of Maui, 1967

Forest reserve and ownership class	Commercial forest type			Total commercial types	Total noncommercial types	Total all types
	Acres					
	Eucalyptus <sup>2/</sup>	Hardwoods	Conifers			
State: <sup>3/</sup>						
Koolau	952	5	--	957	1,671	2,628
Kula	42	89	1,137	1,268	282	1,550
Makawao	172	306	5	483	96	579
Waihou Spring	--	20	12	32	5	37
West Maui	13	--	22	35	15	50
Outside reserve <sup>3/</sup>	11	--	6	17	219	236
Total	1,190	420	1,182	2,792	2,288	5,080
Private:						
Koolau	1,242	2	35	1,279	586	1,865
Kula	--	--	--	--	11	11
West Maui	21	--	21	42	37	79
Outside reserve	1,012	70	868	1,950	1,142	3,092
Total	2,275	72	924	3,271	1,776	5,047
Island total	3,465	492	2,106	6,063	4,064	10,127

1/ Ownership of plantation stands is based on interpretation of locations on Tax-Key maps and topographic maps which are often inadequate for precise determinations. Therefore, for a given plantation stand, the ownership designation may be in error, although over-all ownership statistics are probably not greatly affected by this kind of error.

2/ Includes turpentine-tree and brushbox.

3/ Includes 4 acres of noncommercial types in other public (federal) ownership.

Table 3.—Area of forest plantations by forest type,  
stand size class, and ownership class,  
Island of Maui, 1967

Forest type and stand-size class	Ownership class		All ownerships
	State	Private	
Acres			
Commercial types:			
Sawtimber stands			
Robusta eucalyptus	306	1,561	1,867
Other eucalyptus	100	660	760
Tropical ash	84	--	84
Other hardwoods	54	32	86
Norfolk-Island-pine	--	85	85
Redwood	243	35	278
Sugi	29	35	64
Other conifers	114	61	175
Total	930	2,469	3,399
Poletimber stands			
Eucalyptus <sup>1/</sup>	--	51	51
Other hardwoods	5	40	45
Sugi	74	202	276
Conifers	2	506	508
Total	81	799	880
Seedling & sapling stands			
Saligna eucalyptus	780	--	780
Other eucalyptus	4	3	7
Tropical ash	155	--	155
Other hardwoods	122	--	122
Pines	665	--	665
Other conifers	55	--	55
Total	1,781	3	1,784
Total commercial	2,792	3,271	6,063
Noncommercial types:			
Bluegum eucalyptus	333	1,001	1,334
Other eucalyptus	21	132	153
Paper-bark	1,665	288	1,953
Ironwood	--	328	328
Other hardwoods	5	--	5
Cypress	256	27	283
Other conifers <sup>2/</sup>	8	--	8
Total noncommercial	2,288	1,776	4,064
Total forest plantation	5,080	5,047	10,127

<sup>1/</sup> Includes turpentine-tree and brushbox.

<sup>2/</sup> Includes 4 acres of noncommercial type in other public ownership.



Table 4.—Area of forest plantations by forest type and period of planting, Island of Maui, 1967

Forest type	Period of planting										Total
	1876-1885	1886-1895	1896-1905	1906-1915	1916-1925	1926-1935	1936-1945	1946-1955	1956-1967		
Acres											
Commercial types:											
Robusta eucalyptus	--	--	130	825	472	69	385	--	--	1,881	
Saligna eucalyptus	--	--	--	--	--	--	--	--	780	780	
Other eucalyptus <sup>1/</sup>	80	36	270	145	7	152	107	--	7	804	
Tropical ash	--	--	--	--	--	37	47	--	155	239	
Australian toon	--	--	--	--	--	--	--	--	34	34	
Other hardwoods	--	--	--	2	25	34	70	--	88	219	
Norfolk-Island-pine	--	--	--	11	2	72	--	3	24	112	
Redwood	--	--	--	--	--	106	172	--	28	306	
Sugi	--	--	--	35	--	212	93	--	--	340	
Other conifers	--	--	--	--	--	47	110	526	665	1,348	
Total commercial	80	36	400	1,018	506	729	984	529	1,781	6,063	
Noncommercial types:											
Bluegum eucalyptus	--	--	67	1,101	114	12	29	11	--	1,334	
Other eucalyptus	--	--	--	27	41	74	11	--	--	153	
Paper-bark	--	--	--	--	--	3	1,950	--	--	1,953	
Ironwood	--	--	--	6	273	37	12	--	--	328	
Other hardwoods	--	--	--	--	--	5	--	--	--	5	
Conifers	4	--	6	8	--	12	261	--	--	291	
Total noncommercial	4	--	73	1,142	428	143	2,263	11	--	4,064	
Island total	84	36	473	2,160	934	872	3,247	540	1,781	10,127	

<sup>1/</sup> Includes turpentine-tree and brushbox.

Table 5.—*Volume of growing stock and sawtimber in planted  
sawtimber stands by species and stand acreage,  
Island of Maui, 1967*

(in thousands of feet)

Species	Stands 2 to 4 acres in size		Stands 5 acres and larger		All stands	
	Growing stock	Saw- timber	Growing stock	Saw- timber	Growing stock	Saw- timber
	<i>Cu.ft.</i>	<i>Bd.ft.</i> <sup>1/</sup>	<i>Cu.ft.</i>	<i>Bd.ft.</i> <sup>1/</sup>	<i>Cu.ft.</i>	<i>Bd.ft.</i> <sup>1/</sup>
Robusta eucalyptus	189	878	13,250	71,852	13,439	72,730
Bangalay eucalyptus	--	--	284	1,460	284	1,460
Blackbutt eucalyptus	--	--	31	195	31	195
Gray ironbark eucalyptus	7	35	101	562	108	597
Kinogum eucalyptus	4	16	66	308	70	324
Red-ironbark eucalyptus	--	--	26	115	26	115
Other eucalypts <sup>2/</sup>	153	625	1,435	6,053	1,588	6,678
Hardwoods <sup>3/</sup>	33	128	416	1,360	449	1,488
Redwood	37	183	1,240	6,040	1,277	6,223
Norfolk-Island-pine <sup>4/</sup>	29	90	504	2,844	533	2,934
Sugi	46	176	257	854	303	1,030
Other conifers <sup>5/</sup>	44	177	94	296	138	473
Total	542	2,308	17,704	91,939	18,246	94,247

<sup>1/</sup> International 1/4-inch rule.

<sup>2/</sup> Includes turpentine-tree and brushbox.

<sup>3/</sup> Australian toon, camphor-tree, koa, mahogany, Molucca albizzia, silk-oak, teak, and tropical ash.

<sup>4/</sup> Includes hoop-pine.

<sup>5/</sup> Cluster pine, jelecote pine, Monterey pine, Port-Orford-cedar, and western redcedar.



Table 6.—Volume of growing stock and sawtimber in planted sawtimber stands 5 acres and larger, by ownership class<sup>1</sup> and species, Island of Maui, 1967

(in thousands of feet)

Species	State		Private		Total	
	Growing stock	Saw-timber	Growing stock	Saw-timber	Growing stock	Saw-timber
	<i>Cu.ft.</i>	<i>Bd.ft.</i> <sup>2/</sup>	<i>Cu.ft.</i>	<i>Bd.ft.</i> <sup>2/</sup>	<i>cu.ft.</i>	<i>Bd.ft.</i> <sup>2/</sup>
Robusta eucalyptus	1,111	5,857	12,139	65,995	13,250	71,852
Bangalay eucalyptus	--	--	284	1,460	284	1,460
Blackbutt eucalyptus	--	--	31	195	31	195
Gray ironbark eucalyptus	--	--	101	562	101	562
Kinogum eucalyptus	--	--	66	308	66	308
Red-ironbark eucalyptus	--	--	26	115	26	115
Other eucalypts <sup>3/</sup>	68	263	1,367	5,790	1,435	6,053
Hardwoods <sup>4/</sup>	308	876	108	484	416	1,360
Redwood	1,180	5,790	60	250	1,240	6,040
Norfolk-Island-pine <sup>5/</sup>	--	--	504	2,844	504	2,844
Sugi	139	505	118	349	257	854
Other conifers <sup>6/</sup>	55	188	39	108	94	296
Total	2,861	13,479	14,843	78,460	17,704	91,939

<sup>1/</sup> See footnote 1, Table 2.

<sup>2/</sup> International 1/4-inch rule.

<sup>3/</sup> Includes brushbox

<sup>4/</sup> Australian toon, camphor-tree, koa, Molucca albizzia, silk-oak, and tropical ash.

<sup>5/</sup> Includes hoop-pine.

<sup>6/</sup> Cluster pine, jelecote pine, Monterey pine, Port-Orford-cedar, and western redcedar.

Table 7.—*Volume of growing stock and sawtimber in planted sawtimber stands 2 to 4 acres in size, by ownership class and species, Island of Maui, 1967*

(in thousands of feet)

Species	State		Private		Total	
	Growing stock	Saw-timber	Growing stock	Saw-timber	Growing stock	Saw-timber
	<i>Cu.ft.</i>	<i>Bd.ft.</i> <sup>1/</sup>	<i>Cu.ft.</i>	<i>Bd.ft.</i> <sup>1/</sup>	<i>Cu.ft.</i>	<i>Bd.ft.</i> <sup>1/</sup>
Robusta eucalyptus	145	702	44	176	189	878
Gray ironbark eucalyptus	--	--	7	35	7	35
Kinogum eucalyptus	--	--	4	16	4	16
Other eucalyptus <sup>2/</sup>	71	268	82	357	153	625
Other hardwoods <sup>3/</sup>	13	30	20	98	33	128
Redwood	37	183	--	--	37	183
Norfolk-Island-pine	--	--	29	90	29	90
Sugi	23	115	23	61	46	176
Other conifers <sup>4/</sup>	44	177	--	--	44	177
Total	333	1,475	209	833	542	2,308

<sup>1/</sup> International 1/4-inch rule.

<sup>2/</sup> Includes turpentine-tree and brushbox.

<sup>3/</sup> Mahogany, silk-oak, teak, and tropical ash.

<sup>4/</sup> Cluster pine and Port-Orford-cedar.



Table 8.—Volume of sawtimber and growing stock in planted sawtimber stands 5 acres and larger, by species and diameter class, Island of Maui, 1967

Species	All classes	Tree diameter class (inches at breast height)						Sawtimber in thousand board feet <sup>1/</sup>			plus		
		5.0-10.9	11.0-12.9	13.0-14.9	15.0-16.9	17.0-18.9	19.0-28.9						
Robusta eucalyptus	71,852	--	1,661	3,209	5,290	6,989	40,732	12,414	1,557				
Bangalay eucalyptus	1,460	--	24	37	45	96	854	357	47				
Other eucalypts <sup>2/</sup>	7,233	--	359	583	617	846	2,941	1,204	683				
Hardwoods <sup>3/</sup>	1,360	--	90	243	191	223	395	175	43				
Redwood	6,040	--	149	308	543	773	3,469	777	21				
Norfolk-Island-pine <sup>4/</sup>	2,844	--	22	129	474	812	1,407	--	--				
Other conifers <sup>5/</sup>	1,150	--	159	219	251	201	301	19	--				
Total	91,939	--	2,464	4,728	7,411	9,940	50,099	14,946	2,351				
Growing stock in thousand cubic feet													
Robusta eucalyptus	13,250	258	622	821	1,095	1,306	6,932	1,990	226				
Bangalay eucalyptus	284	5	10	9	10	19	157	66	8				
Other eucalypts <sup>2/</sup>	1,659	88	171	176	149	184	562	211	118				
Hardwoods <sup>3/</sup>	416	81	47	69	50	50	77	32	10				
Redwood	1,240	60	91	81	111	145	613	135	4				
Norfolk-Island-pine <sup>4/</sup>	504	2	7	27	87	141	240	--	--				
Other conifers <sup>5/</sup>	351	75	62	59	55	40	56	4	--				
Total	17,704	569	1,010	1,242	1,557	1,885	8,637	2,438	366				

<sup>1/</sup> International 1/4-inch rule.

<sup>2/</sup> Includes brushbox.

<sup>3/</sup> Australian toon, camphor-tree, koa, Molucca albizzia, silk-oak, and tropical ash.

<sup>4/</sup> Includes hoop-pine.

<sup>5/</sup> Cluster pine, jelecote pine, Monterey pine, Port-Orford cedar, sugi, and western redcedar.

Table 9.—*Volume of cull trees in planted sawtimber stands  
5 acres and larger by species and forest reserve,  
Island of Maui, 1967*

Species	Forest reserve				Total
	Koolau	Kula	West Maui	Outside reserve	
<i>Thousand cubic feet</i>					
Robusta eucalyptus	264	2	--	53	319
Other eucalypts	183	2	4	73	262
Other hardwoods <sup>1/</sup>	203	41	--	6	250
Conifers <sup>2/</sup>	2	40	--	13	55
Total	652	85	4	145	886

<sup>1/</sup> Australian toon, black-wattle acacia, fig, Formosa koa, koa, kukui, mamani, Molucca albizzia, olapa, paper-bark, pride-of-India, and tropical ash.

<sup>2/</sup> Includes cypress, ironwood, jelecote pine, western red-cedar, redwood, and sugi.

Table 10.—Sawtimber volume in planted sawtimber stands 5 acres and larger by ownership class, species, and log grade,<sup>1</sup>  
Island of Maui, 1967

Ownership class and species	All grades	Factory lumber logs			Tie and timber logs	Softwood species <u>2/</u>
		Grade 1	Grade 2	Grade 3	Grade 4	
<i>Thousand board feet<sup>3/</sup></i>						
State:						
Robusta eucalyptus	5,857	1,435	661	859	2,902	--
Other eucalypts <sup>4/</sup>	262	11	12	24	215	--
Hardwoods <sup>5/</sup>	877	--	--	51	826	--
Commercial conifers <sup>6/</sup>	6,483	--	--	--	--	6,483
Total	13,479	1,446	673	934	3,943	6,483
Private:						
Robusta eucalyptus	65,995	16,210	8,072	9,573	32,140	--
Bangalay eucalyptus	1,460	388	243	235	594	--
Blackbutt eucalyptus	195	41	16	28	110	--
Gray ironbark eucalyptus	562	134	53	89	286	--
Kinogum eucalyptus	308	14	24	39	231	--
Red-ironbark eucalyptus	115	16	13	19	67	--
Other eucalypts <sup>4/</sup>	5,790	371	417	850	4,152	--
Other hardwoods <sup>5/</sup>	484	138	10	144	192	--
Commercial conifers <sup>7/</sup>	3,551	--	--	--	--	3,551
Total	78,460	17,312	8,848	10,977	37,772	3,551
All ownerships:						
Robusta eucalyptus	71,852	17,640	8,733	10,432	35,042	--
Bangalay eucalyptus	1,460	388	243	235	594	--
Blackbutt eucalyptus	195	41	16	28	110	--
Gray ironbark eucalyptus	562	134	53	89	286	--
Kinogum eucalyptus	308	14	24	39	231	--
Red-ironbark eucalyptus	115	16	13	19	67	--
Other eucalypts <sup>4/</sup>	6,052	382	429	874	4,367	--
Other hardwoods <sup>5/</sup>	1,361	138	10	195	1,018	--
Commercial conifers	10,034	--	--	--	--	10,034
Total	91,939	18,758	9,521	11,911	41,715	10,034

<sup>1/</sup> Based on standard specifications for hardwood log grades for standard lumber.

<sup>2/</sup> Commercial conifer species are not log graded.

<sup>3/</sup> International 1/4-inch rule.

<sup>4/</sup> Includes brushbox.

<sup>5/</sup> Includes Australian toon, camphor-tree, koa, Molucca albizzia, silk-oak, and tropical ash.

<sup>6/</sup> Mainly redwood but includes sugi, cluster pine, jelecote pine, Monterey pine, Port-Orford-cedar, and western redcedar.

<sup>7/</sup> Mainly Norfolk-Island-pine but includes redwood, sugi, and Port-Orford-cedar.



Table 11.—*Listing of individual stands and plantings with forest type, ownership, area, and volume*  
Island of Maui, 1967

FORESTS PLANTED BEFORE 1950

Stand No.	Forest type	Owner	Acres	Total stand volume
				MBF
6001	Eucalyptus	Private	5	( <u>1</u> /)
6002	Eucalyptus	Private	16	161
6003	Eucalyptus	Private	21	120
6004	Eucalyptus	Private	15	181
6005	Eucalyptus	Private	17	148
6006	Eucalyptus	Private	4	33
6007	Eucalyptus	Private	13	107
6008	Ironwood	Private	4	( <u>1</u> /)
6009	Honduras mahogany	Private	2	34
6010	Norfolk-Island-pine	Private	5	165
6011	Eucalyptus	Private	8	26
6012	Eucalyptus	Private	3	25
6013	Eucalyptus	Private	5	26
6014	Eucalyptus	Private	10	96
6015	Eucalyptus	Private	2	10
6016	Juniper	Private	24	( <u>2</u> /)
6017	Norfolk-Island-pine	Private	14	295
6018	Sugi	Private	82	( <u>2</u> /)
6019	Norfolk-Island-pine	Private	41	1,554
6020	Sugi	Private	38	( <u>2</u> /)
6021	Ironwood	Private	22	( <u>1</u> /)
6022	Ironwood	Private	73	( <u>1</u> /)
6023	Robusta eucalyptus	Private	79	358
6024	Ironwood	Private	12	( <u>1</u> /)
6025	Ironwood	Private	13	( <u>1</u> /)
6026	Eucalyptus	Private	7	( <u>1</u> /)
6027	Robusta eucalyptus	Private	17	23
6028	Robusta eucalyptus	Private	26	25
6029	Eucalyptus	Private	8	( <u>2</u> /)
6030	Eucalyptus	Private	15	( <u>1</u> /)

See footnotes at end of Table.

Table 11, continued

## FORESTS PLANTED BEFORE 1950

Stand No.	Forest type	Owner	Acres	Total stand volume
6031	Robusta eucalyptus	Private	12	65
6032	Ironwood	Private	33	(1/)
6033	Robusta eucalyptus	Private	12	234
6034	Eucalyptus	Private	7	93
6035	Eucalyptus	Private	8	74
6036	Eucalyptus	Private	20	215
6037	Eucalyptus	Private	13	110
6038	Eucalyptus	Private	8	112
6039	Bluegum eucalyptus	Private	24	(1/)
6040	Bluegum eucalyptus	Private	11	(1/)
6041	Bluegum eucalyptus	Private	12	(1/)
6042	Silk-oak	Private	16	(2/)
6043	Eucalyptus	Private	6	22
6044	Eucalyptus	Private	38	369
6045	Bangalay eucalyptus	Private	16	613
6046	Eucalyptus	Private	4	37
6047	Bluegum eucalyptus	Private	3	(1/)
6048	Bluegum eucalyptus	Private	3	(1/)
6049	Bluegum eucalyptus	Private	6	(1/)
6050	Bluegum eucalyptus	Private	3	(1/)
6051	Bluegum eucalyptus	Private	12	(1/)
6052	Bluegum eucalyptus	Private	17	(1/)
6053	Bluegum eucalyptus	Private	80	(1/)
6054	Pines	State	4	7
6055	Cluster pine	State	2	3
6056	Bluegum eucalyptus	Private	9	(1/)
6057	Bluegum eucalyptus	Private	42	(1/)
6058	Bluegum eucalyptus	Private	8	(1/)
6059	Eucalyptus	State	4	14
6060	Pines	State	2	24

See footnotes at end of Table.

Table 11, continued

## FORESTS PLANTED BEFORE 1950

Stand No.	Forest type	Owner	Acres	Total stand volume
6061	Bluegum eucalyptus	Private	7	( <u>1</u> /)
6062	Bluegum eucalyptus	Private	9	( <u>1</u> /)
6063	Bluegum eucalyptus	Private	8	( <u>1</u> /)
6064	Bluegum eucalyptus	Private	10	( <u>1</u> /)
6065	Bluegum eucalyptus	Private	9	( <u>1</u> /)
6066	Eucalyptus	Private	43	1,087
6067	Cypress	Private	4	( <u>1</u> /)
6068	Eucalyptus	Private	18	315
6069	Eucalyptus	Private	11	39
6070	Eucalyptus	Private	2	7
6071	Bluegum eucalyptus	Private	2	( <u>1</u> /)
6072	Bluegum eucalyptus	Private	8	( <u>1</u> /)
6073	Bluegum eucalyptus	Private	16	( <u>1</u> /)
6074	Bluegum eucalyptus	Private	6	( <u>1</u> /)
6075	Bluegum eucalyptus	Private	65	( <u>1</u> /)
6076	Bangalay eucalyptus	Private	29	333
6077	Bangalay eucalyptus	Private	17	230
6078	Eucalyptus	Private	7	126
6079	Eucalyptus	Private	2	36
6080	Monterey cypress	Private	6	( <u>1</u> /)
6081	Conifers	Private	120	( <u>2</u> /)
6082	Redwood	Private	35	250
6083	Monterey cypress	Private	5	( <u>1</u> /)
6084	Conifers	Other public	4	( <u>1</u> /)
6085	Eucalyptus	Private	15	( <u>1</u> /)
6086	Bluegum eucalyptus	Private	8	( <u>1</u> /)
6087	Bluegum eucalyptus	Private	11	( <u>1</u> /)
6088	Eucalyptus	Private	12	251
6089	Bluegum eucalyptus	Private	17	( <u>1</u> /)
6090	Bluegum eucalyptus	State	8	( <u>1</u> /)

See footnotes at end of Table.



Table 11, continued

## FORESTS PLANTED BEFORE 1950

Stand No.	Forest type	Owner	Acres	Total stand volume
6091	Bluegum eucalyptus	Private	5	(1/)
6092	Bluegum eucalyptus	Private	12	(1/)
6093	Bluegum eucalyptus	State	44	(1/)
6094	Bluegum eucalyptus	State	36	(1/)
6095	Bluegum eucalyptus	State	27	(1/)
6096	Bluegum eucalyptus	State	23	(1/)
6097	Bluegum eucalyptus	State	21	(1/)
6098	Bluegum eucalyptus	Private	11	(1/)
6099	Eucalyptus	Private	30	331
6100	Eucalyptus	Private	45	719
6101	Eucalyptus	State	6	(1/)
6102	Robusta eucalyptus	State	4	58
6103	Hardwoods & conifers	State	34	(3/)
6104	Paper-bark	State	9	(1/)
6105	Eucalyptus	State	4	37
6106	Paper-bark	State	90	(1/)
6107	Norfolk-Island-pine	Private	11	834
6108	Ironwood	Private	6	(1/)
6109	Eucalyptus	Private	50	517
6110	Bluegum eucalyptus	Private	3	(1/)
6111	Robusta eucalyptus	Private	88	5,476
6112	Robusta eucalyptus	Private	5	169
6113	Bluegum eucalyptus	Private	103	(1/)
6114	Robusta eucalyptus	Private	96	6,639
6115	Robusta eucalyptus	Private	34	1,743
6116	Robusta eucalyptus	Private	108	7,178
6117	Sugi	Private	3	19
6118	Robusta eucalyptus	Private	94	7,289
6119	Paper-bark	State	13	(1/)
6120	Paper-bark	Private	42	(1/)

See footnotes at end of Table.

Table 11, continued

## FORESTS PLANTED BEFORE 1950

Stand No.	Forest type	Owner	Acres	Total stand volume
6121	Robusta eucalyptus	State	70	733
6122	Paper-bark	Private	25	( <u>1</u> /)
6123	Robusta eucalyptus	State	4	76
6124	Robusta eucalyptus	Private	15	219
6125	Paper-bark	State	39	( <u>1</u> /)
6126	Paper-bark	State	71	( <u>1</u> /)
6127	Eucalyptus	Private	21	144
6128	Robusta eucalyptus	State	4	76
6129	Robusta eucalyptus	State	36	483
6130	Robusta eucalyptus	Private	20	1,196
6131	Robusta eucalyptus	Private	30	912
6132	Robusta eucalyptus	Private	17	525
6133	Eucalyptus	Private	21	243
6134	Eucalyptus	Private	10	151
6135	Kinogum eucalyptus	Private	7	192
6136	Bluegum eucalyptus	Private	24	( <u>1</u> /)
6137	Bluegum eucalyptus	Private	10	( <u>1</u> /)
6138	Eucalyptus	Private	12	70
6139	Bluegum eucalyptus	Private	36	( <u>1</u> /)
6140	Bluegum eucalyptus	State	56	( <u>1</u> /)
6141	Brushbox	State	4	3
6142	Bluegum eucalyptus	State	88	( <u>1</u> /)
6143	Robusta eucalyptus	Private	25	1,235
6144	Eucalyptus	Private	12	( <u>1</u> /)
6145	Eucalyptus	State	7	153
6146	Robusta eucalyptus	Private	54	4,331
6147	Bluegum eucalyptus	Private	14	( <u>1</u> /)
6148	Bluegum eucalyptus	Private	18	( <u>1</u> /)
6149	Robusta eucalyptus	Private	10	107
6150	Robusta eucalyptus	State	4	58

See footnotes at end of Table.

Table 11, continued

## FORESTS PLANTED BEFORE 1950

Stand No.	Forest type	Owner	Acres	Total stand volume
6151	Bluegum eucalyptus	Private	71	(1/)
6152	Robusta eucalyptus	Private	42	3,078
6153	Bluegum eucalyptus	State	8	(1/)
6154	Sugi	Private	3	41
6155	Robusta eucalyptus	Private	104	5,640
6156	Robusta eucalyptus	Private	27	678
6157	Robusta eucalyptus	Private	37	1,174
6158	Eucalyptus	State	20	(3/)
6159	Sugi	Private	12	165
6160	Sugi	Private	12	228
6161	Robusta eucalyptus	Private	49	2,615
6162	Robusta eucalyptus	Private	49	1,203
6163	Robusta eucalyptus	Private	104	2,089
6164	Robusta eucalyptus	Private	98	1,877
6165	Paper-bark	State	11	(1/)
6166	Paper-bark	State	10	(1/)
6167	Robusta eucalyptus	Private	54	2,194
6168	Robusta eucalyptus	State	17	415
6169	Robusta eucalyptus	State	21	574
6170	Robusta eucalyptus	State	13	232
6171	Paper-bark	State	34	(1/)
6172	Robusta eucalyptus	State	4	76
6173	Robusta eucalyptus	State	4	76
6174	Paper-bark	State	167	(1/)
6175	Robusta eucalyptus	State	4	76
6176	Paper-bark	State	17	(1/)
6177	Paper-bark	Private	5	(1/)
6178	Paper-bark	State	25	(1/)
6179	Paper-bark	State	17	(1/)
6180	Paper-bark	State	22	(1/)

See footnotes at end of Table.



Table 11, continued

## FORESTS PLANTED BEFORE 1950

Stand No.	Forest type	Owner	Acres	Total stand volume
6181	Robusta eucalyptus	Private	27	494
6182	Ironwood	Private	12	( <u>1</u> /)
6183	Robusta eucalyptus	Private	4	22
6184	Robusta eucalyptus	Private	4	22
6185	Robusta eucalyptus	State	4	58
6186	Paper-bark	State	38	( <u>1</u> /)
6187	Paper-bark	State	7	( <u>1</u> /)
6188	Paper-bark	State	12	( <u>1</u> /)
6189	Robusta eucalyptus	State	4	58
6190	Paper-bark	State	9	( <u>1</u> /)
6191	Paper-bark	State	33	( <u>1</u> /)
6192	Paper-bark	State	14	( <u>1</u> /)
6193	Robusta eucalyptus	Private	4	54
6194	Robusta eucalyptus	State	4	54
6195	Paper-bark	State	4	( <u>1</u> /)
6196	Paper-bark	State	105	( <u>1</u> /)
6197	Paper-bark	State	13	( <u>1</u> /)
6198	Paper-bark	State	23	( <u>1</u> /)
6199	Paper-bark	State	21	( <u>1</u> /)
6200	Robusta eucalyptus	State	17	1,097
6201	Robusta eucalyptus	State	17	980
6202	Paper-bark	State	54	( <u>1</u> /)
6203	Eucalyptus	Private	11	155
6204	Sugi	Private	36	( <u>2</u> /)
6205	Paper-bark	Private	15	( <u>1</u> /)
6206	Paper-bark	Private	15	( <u>1</u> /)
6207	Juniper	Private	15	( <u>2</u> /)
6208	Paper-bark	Private	81	( <u>1</u> /)
6209	Robusta eucalyptus	Private	12	182
6210	Eucalyptus	Private	7	85

See footnotes at end of Table.

Table 11, continued

## FORESTS PLANTED BEFORE 1950

Stand No.	Forest type	Owner	Acres	Total stand volume
6211	Paper-bark	Private	69	( <u>1</u> /)
6212	Robusta eucalyptus	Private	30	330
6213	Robusta eucalyptus	State	22	417
6214	Bangalay eucalyptus	Private	11	261
6215	Robusta eucalyptus	Private	12	813
6216	Paper-bark	Private	10	( <u>1</u> /)
6217	Cypress	Private	2	( <u>1</u> /)
6218	Brushbox	State	4	3
6219	Robusta eucalyptus	Private	17	685
6220	Redwood	State	9	645
6221	Bluegum eucalyptus	Private	17	( <u>1</u> /)
6222	Bluegum eucalyptus	Private	195	( <u>1</u> /)
6223	Robusta eucalyptus	Private	74	4,963
6224	Sugi	Private	5	32
6225	Bluegum eucalyptus	Private	12	( <u>1</u> /)
6226	Bluegum eucalyptus	Private	9	( <u>1</u> /)
6227	Brushbox	Private	14	10
6228	Brushbox	Private	6	( <u>2</u> /)
6229	Robusta eucalyptus	Private	14	( <u>2</u> /)
6230	Brushbox	Private	4	( <u>2</u> /)
6231	Eucalyptus	Private	2	18
6232	Eucalyptus	Private	4	14
6233	Norfolk-Island-pine	Private	4	7
6234	Hardwoods & conifers	State	20	( <u>3</u> /)
6235	Redwood	State	23	235
6236	Hardwoods	State	5	( <u>1</u> /)
6237	Robusta eucalyptus	Private	4	58
6238	Eucalyptus	Private	3	( <u>2</u> /)
6239	Robusta eucalyptus	Private	20	299
6240	Paper-bark	Private	15	( <u>1</u> /)

See footnotes at end of Table.

Table 11, continued

## FORESTS PLANTED BEFORE 1950

Stand No.	Forest type	Owner	Acres	Total stand volume
6241	Paper-bark	State	6	( <u>1</u> /)
6242	Robusta eucalyptus	State	45	938
6243	Paper-bark	Private	8	( <u>1</u> /)
6244	Eucalyptus	Private	8	64
6245	Pines	Private	19	( <u>2</u> /)
6246	Pines	Private	60	( <u>2</u> /)
6247	Pines	Private	56	( <u>2</u> /)
6248	Conifers	Private	119	( <u>2</u> /)
6249	Pines	Private	8	( <u>2</u> /)
6250	Pines	Private	39	85
6251	Conifers	Private	70	( <u>2</u> /)
6252	Pines	Private	22	22
6253	Bluegum eucalyptus	Private	34	( <u>1</u> /)
6254	Bluegum eucalyptus	Private	3	( <u>1</u> /)
6255	Bluegum eucalyptus	Private	11	( <u>1</u> /)
6256	Redwood	State	29	434
6257	Monterey cypress	State	12	( <u>1</u> /)
6258	Sugi	State	48	( <u>2</u> /)
6259	Sugi	State	2	48
6260	Eucalyptus	State	34	109
6261	Mountain albizzia	State	5	( <u>2</u> /)
6262	Monterey cypress	State	27	( <u>1</u> /)
6263	Monterey cypress	State	19	( <u>1</u> /)
6264	Cluster pine	State	4	9
6265	Eucalyptus	State	4	23
6266	Bluegum eucalyptus	State	3	( <u>1</u> /)
6267	Bluegum eucalyptus	State	9	( <u>1</u> /)
6268	Bluegum eucalyptus	State	10	( <u>1</u> /)
6269	Eucalyptus	State	2	11
6270	Eucalyptus	State	2	11

See footnotes at end of Table.



Table 11, continued

## FORESTS PLANTED BEFORE 1950

Stand No.	Forest type	Owner	Acres	Total stand volume
6271	Sugi	State	19	(2/)
6272	Sugi	State	7	(2/)
6273	Port-Orford-cedar	State	4	134
6274	Redwood	State	80	91
6275	Tropical ash	State	6	1
6276	Redwood	State	20	170
6277	Tropical ash	State	21	138
6278	Redwood	State	44	2,009
6279	Sugi	State	2	67
6280	Redwood	State	16	488
6281	Tropical ash	State	19	170
6282	Redwood	State	8	457
6283	Tropical ash	State	3	20
6284	Tropical ash	State	6	34
6285	Redwood	State	4	122
6286	Redwood	State	2	61
6287	Tropical ash	State	4	7
6288	Monterey cypress	State	73	(1/)
6289	Tropical ash	State	2	3
6290	Hardwoods & conifers	State	40	471
6291	Tropical ash	State	8	13
6292	Conifers	State	6	10
6293	Monterey cypress	State	125	(1/)
6294	Silk-oak	Private	7	(2/)
6295	Conifers	State	4	(1/)
6296	Sugi	State	5	81
6297	Sugi	State	7	129
6298	Sugi	State	5	12
6299	Hardwoods & conifers	State	23	468
6300	Redwood	State	17	702

See footnotes at end of Table.

Table 11, continued

## FORESTS PLANTED BEFORE 1950

Stand No.	Forest type	Owner	Acres	Total stand volume
6301	Redwood	State	11	71
6302	Ironwood	Private	4	( <u>1</u> /)
6303	Eucalyptus	Private	9	( <u>1</u> /)
6304	Ironwood	Private	5	( <u>1</u> /)
6305	Eucalyptus	Private	6	( <u>1</u> /)
6306	Ironwood	Private	8	( <u>1</u> /)
6307	Ironwood	Private	13	( <u>1</u> /)
6308	Ironwood	Private	4	( <u>1</u> /)
6309	Eucalyptus	Private	6	( <u>1</u> /)
6310	Lemon-gum eucalyptus	Private	2	( <u>2</u> /)
6311	Ironwood	Private	6	( <u>1</u> /)
6312	Robusta eucalyptus	Private	29	195
6313	Ironwood	Private	14	( <u>1</u> /)
6314	Ironwood	Private	4	( <u>1</u> /)
6315	Molucca albizzia	Private	25	365
6316	Ironwood	Private	11	( <u>1</u> /)
6317	Robusta eucalyptus	Private	11	181
6318	Robusta eucalyptus	Private	9	15
6319	Ironwood	Private	5	( <u>1</u> /)
6320	Sugi	Private	33	( <u>2</u> /)
6321	Silk-oak	Private	5	( <u>2</u> /)
6322	Eucalyptus	Private	5	( <u>1</u> /)
6323	Ironwood	Private	9	( <u>1</u> /)
6324	Norfolk-Island-pine	Private	4	21
6325	Hardwoods	Private	3	52
6326	Paper-bark	Private	3	( <u>1</u> /)
6327	Norfolk-Island-pine	Private	2	42
6328	Ironwood	Private	2	( <u>1</u> /)
6329	Ironwood	Private	4	( <u>1</u> /)
6330	Ironwood	Private	5	( <u>1</u> /)

See footnotes at end of Table.

Table 11, continued

## FORESTS PLANTED BEFORE 1950

Stand No.	Forest type	Owner	Acres	Total stand volume
6331	Cypress	Private	4	( <u>1</u> /)
6332	Eucalyptus	Private	13	170
6333	Sugi	Private	3	( <u>2</u> /)
6334	Eucalyptus	Private	15	( <u>1</u> /)
6335	Silk-oak	Private	3	( <u>2</u> /)
6336	Eucalyptus	Private	12	( <u>1</u> /)
6337	Eucalyptus	Private	8	( <u>1</u> /)
6338	Eucalyptus	Private	8	( <u>1</u> /)
6339	Silk-oak	Private	6	( <u>2</u> /)
6340	Cypress	Private	6	( <u>1</u> /)
6341	Eucalyptus	Private	3	( <u>1</u> /)
6342	Eucalyptus	Private	3	25
6343	Hardwoods	Private	2	6
6344	Ironwood	Private	4	( <u>1</u> /)
6345	Eucalyptus	Private	6	73
6346	Kinogum eucalyptus	Private	2	16
6347	Silk-oak	Private	3	( <u>2</u> /)
6348	Brushbox	Private	14	( <u>2</u> /)
6349	Sugi	Private	3	( <u>2</u> /)
6350	Sugi	Private	4	( <u>2</u> /)
6351	Western redcedar	State	9	39
6352	Tropical ash	State	15	212
6353	Sugi	State	8	267
6354	Sugi	Private	3	( <u>2</u> /)
6355	Eucalyptus	Private	2	( <u>1</u> /)
6356	Norfolk-Island-pine	Private	2	10
6357	Eucalyptus	State	15	( <u>1</u> /)
6358	Eucalyptus	State	3	35
6359	Ironwood	Private	4	( <u>1</u> /)
6360	Ironwood	Private	10	( <u>1</u> /)

See footnotes at end of Table.



Table 11, continued

## FORESTS PLANTED BEFORE 1950

Stand No.	Forest type	Owner	Acres	Total stand volume
6361	Ironwood	Private	4	(1/)
6362	Ironwood	Private	4	(1/)
6363	Ironwood	Private	7	(1/)
6364	Ironwood	Private	3	(1/)
6365	Robusta eucalyptus	Private	3	20
6366	Ironwood	Private	5	(1/)
6367	Lemon-gum eucalyptus	Private	2	14
6368	Ironwood	Private	14	(1/)
6369	Ironwood	Private	4	(1/)
6370	Gray ironbark eucalyptus	Private	2	35
6371	Bluegum eucalyptus	Private	4	(1/)
6372	Brushbox	State	4	3
6373	Saligna eucalyptus	Private	2	132
6374	Silk-oak	Private	2	12
6375	Norfolk-Island-pine	Private	2	10
6376	Eucalyptus	Private	4	(1/)
6377	Port-Orford-cedar	Private	2	(2/)
6378	Pines	Private	13	(2/)
6379	Paper-bark	State	18	(1/)
6380	Paper-bark	State	20	(1/)
6381	Paper-bark	State	13	(1/)
6382	Eucalyptus	State	4	43
6383	Robusta eucalyptus	State	4	18
6384	Robusta eucalyptus	State	4	18
6385	Paper-bark	State	25	(1/)
6386	Eucalyptus	State	4	84
6387	Paper-bark	State	67	(1/)
6388	Paper-bark	State	160	(1/)
6389	Paper-bark	State	63	(1/)
6390	Paper-bark	State	194	(1/)

See footnotes at end of Table.

Table 11, continued

## FORESTS PLANTED BEFORE 1950

Stand No.	Forest type	Owner	Acres	Total stand volume
6391	Paper-bark	State	121	(1/)
6392	Paper-bark	State	120	(1/)
6393	China-fir	State	2	(2/)
6394	Bluegum eucalyptus	Private	3	(1/)
Total			8,343	94,247

See footnotes at end of Table.

Table 11, continued

AREAS REFORESTED 1950-67<sup>4/</sup>

Stand No.	Forest type	Owner	Acres	Total stand volume
Koolau Forest Reserve:				
--	Australian toon	State	5	(2/)
--	Bagras eucalyptus	State	4	(2/)
--	Hardwoods	State	51	(2/)
--	Saligna eucalyptus	State	587	(2/)
Total Koolau F. R.			647	--
Kula Forest Reserve:				
--	Pines	State	622	(2/)
--	Monterey pine	State	33	(2/)
	Redwood	State	28	(2/)
Total Kula F. R.			683	--
Makawao Forest Reserve:				
--	Australian toon	State	29	(2/)
--	Koa <sup>5/</sup>	State	45	(2/)
--	Mountain albizzia	State	1	(2/)
--	Norfolk-Island-pine	State	5	(2/)
--	Saligna eucalyptus	State	98	(2/)
--	Hardwoods	State	76	(2/)
--	Tropical ash	State	155	(2/)
Total Makawao F. R.			409	--

See footnotes at end of Table.



Table 11, continued

AREAS REFORESTED 1950-67<sup>4/</sup>

Stand No.	Forest type	Owner	Acres	Total stand volume
Waihou Spring Forest Reserve:				
--	Pines	State	4	( <u>2/</u> )
Total Waihou Spring F. R.			4	--
West Maui Forest Reserve:				
--	Norfolk-Island-pine	State	22	( <u>2/</u> )
--	Saligna eucalyptus	State	10	( <u>2/</u> )
Total West Maui F. R.			32	--
Outside Forest Reserve:				
--	Loblolly pine <sup>6/</sup>	State	6	( <u>2/</u> )
--	Pines and bagras eucalyptus <sup>7/</sup>	Private	3	( <u>2/</u> )
Total Outside F. R.			9	--
Total			1,784	--
Total forest plantations			10,127	94,247

<sup>1/</sup> Noncommercial plantation type.<sup>2/</sup> Poletimber or seedling and sapling stands.<sup>3/</sup> No volume estimated-experimental planting.<sup>4/</sup> No stand numbers assigned.<sup>5/</sup> Natural regeneration.<sup>6/</sup> Experimental pine planting-Olinda.<sup>7/</sup> Baldwin planting-Puu Pane.

Table 12.—*Identity of individual plantation stands in the groups shown on the map "Forest Plantations on the Island of Maui, 1967"*<sup>1</sup>

Group stand No.	Individual stand number
1	6013-20; 6204, 07; 6320, 6345-46, 49-50
2	6001-8, 10-12; 6217; 6328-34, 36-43, 55
3	6009; 6294; 6321-27, 35, 47-48, 56
4	6025-26, 32-33; 6127, 33; 6311-19, 57-66
5	6021-24, 27-28, 31; 6302-10, 67-69
6	6056, 58, 65-70, 88, 98-99; 6100; 6203, 10; 6370
7	6029-30; 6107-09; 6226, 33, 37
8	6094-97; 6220, 35, 56-59, 61-93, 95-99; 6300-01, 51-53, 93
9	6110-13, 48; 6225; 6354, 94
10	6034-47; 6134-37, 39; 6214, 25, 27-32
11	6086-87, 89-93; 6253-54
12	6048-55, 57, 59-64, 71-74; 6234, 36; 6375
13	6075-79, 85
14	6114-18, 46-47, 49; 6224; 6371
15	6103, 41-45, 50-64, 67; 6215, 18-19, 21-23; 6372-74
16	6080-84; 6244-52; 6376-78
17	6101-02, 04-06, 19-22; 6238-43; 6379-81
18	6116, 23-26, 28-32, 65, 72-73, 75-77, 84-85, 90, 93-95; 6206, 08-09, 11-13
19	6166, 68-71, 74, 76, 79-80, 86-89, 91-92, 96-99; 6200-02, 05
20	6382-92
21	6181
22	6182-83

<sup>1/</sup> Unnumbered stands on the map are identified by symbols as follows:

KORP--Koolau F.R. reforestation planting, 1960-67; includes seedling, sapling, and poletimber.

KRP --Kula F.R. reforestation planting, 1950-67; includes seedling, sapling, and poletimber.

MRP --Makawao F.R. reforestation planting, 1962-65; includes seedling, sapling, and poletimber.

WSRP--Waihou Spring F.R. reforestation planting, 1956-65; includes seedling, sapling, and poletimber.

WMRP--West Maui F.R. reforestation planting, 1950-62; includes seedling, sapling, and poletimber.





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OXFORD: (969):228.7—05.

RETRIEVAL TERMS: planted forests; surveys; stand composition; stand volume; forest ownership; Hawaii (Maui).

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- . . . Conducts forest and range research at more than 75 locations from Puerto Rico to Alaska and Hawaii.
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